REMARKS

Status of this application

In the Office Action mailed on May 22, 2003, claims 1-26 were rejected in view of Kim et al. Patent 6,040,936 in combination with other references as shown in the table below:

Claims	Basis	Reference(s)
1-3, 5 and 21	§102(e)	Kim et al. Patent 6,040,936
4, 6, 8 and 22-25	§103(a)	Kim et al. Patent 6,040,936
7, 9-13 and 26	§103(a)	Kim et al. Patent 6,040,936 + Thio Patent 6,441,298
14-20	§103(a)	Kim et al. Patent 6,040,936 + Ebbesen et al. Patent 6,236,030

This response amends claims 1, 2, 14 and 21 to more clearly define applicant's invention and requests reconsideration of claims 1-26 as amended for the reasons presented below.

In the outstanding Action, the drawings were objected to for failure to include reference number 106 mentioned on page 14, line 28 of applicant's specification. As the Examiner surmised, the error was in the specification, and not the drawing, and page 14, line 28 is being amended to refer instead to the numeral 105 to correct this error. A new sheet of drawings which adds the legend "Prior Art" to Figures 1-3, inadvertently omitted from these figures as filed, is being submitted with this response.

The Applicant's Invention

Applicant's invention as claimed illuminates a target with an extremely small spot of light. A light source illuminates an electrically conductive surface formed on one face of a light barrier and the light from the source passes through a sub-wavelength sized aperture in the light barrier to the target positioned near the exit of the aperture at the opposing surface of the light barrier. The small spot size is achieved by employing means for confining the extent of electronic excitation induced in the second surface to that portion of the second surface that is near the aperture. A variety of different embodiments of the invention are disclosed and claimed which utilize different structures to confine the electronic excitation on the exit surface to a region close to the aperture.

The Cited Kim et al. Patent 6,040,936

Kim et al. also employ a light barrier which includes a thin, perforated metal film having a conductive surface exposed to a light source. The light from the source passes through each of an array of sub-wavelength sized apertures through the film. In the Kim et al. arrangement, as in applicant's invention, an array of apertures is preferably used to enhance the amount of light transmitted through the apertures.

In the cited Kim et al. Patent 6,040,936, the perforated metal film is placed adjacent to a support layer having a selectively variable refractive index. By varying the refractive index of the adjacent support layer, Kim et al. modulate the intensity of the light passing through the perforated film.

The cited Kim et al. Patent is not concerned with, and does not teach, any mechanism for restricting the illumination spot size created by the light passing through the apertures. Kim et al. do not describe any mechanism or method for confining the extent of the electronic excitation induced in the exit surface to that portion of the exit surface that is near each aperture.

For convenience, the discussion of the differences between the subject matter set forth in claims 1-26 and the prior art cited by the Examiner will be presented in the same order in which the cited art was discussed in the outstanding Office Action.

Claim Rejections – 35 U.S.C. §102

Claims 1-3, 5 and 21 were rejected as being anticipated by Kim et al. Reconsideration of this rejection is requested.

As noted by the Examiner, Figs. 12A and 12B of the Kim et al. patent show a flat panel display device consisting of a source of electromagnetic radiation 100 which illuminates a conductive surface formed by the perforated metal film 102. The Examiner suggests that the substrate 118 defines a second surface which is adjacent to an auxiliary layer (the substrate 118) which is said to be a "target."

It is submitted that the structure shown in Figs. 12A and 12B are wholly different from the structure clearly set forth in claim 1. Claim 1 states that the sub-wavelength width apertures pass through the light barrier from its first surface to its second surface. The only light barrier in Figs. 12A and 12B that meet that description is the perforated metal film 102. There is no

suggestion in the Kim et al. disclosure that the apertures pass through any of the layers 101-118 other than the perforated metal film 102. While it is true that varying the refractive index of the liquid crystal solution 104 seen in Fig. 12A would vary the intensity of the light passing through the surface of the substrate 118, the surface of the substrate 118 is not located at surface of the light barrier through which the apertures extend as claimed. Moreover, there is no disclosure or suggestion in the Kim et al. reference that varying the refractive index of the material adjacent to the metal film would or should confine the extent of the electronic excitation to that portion of the exit surface that is near each aperture. Independent claims 1, 14 and 21 have been amended to clarify these distinctions.

The Kim et al. liquid crystal solution, when subjected to a variable electric field, changes its refractive index to vary the amount of light transmitted outwardly through the transparent conductive electrode 117 and the substrate 118. There is no suggestion anywhere in the Kim et al. patent that the liquid crystal solution 104, or anything else in the structure shown in Figs. 12A and 12B of the Kim et al. patent, limits the area in which electronic excitation is induced to a confined area near the aperture exit in order to illuminate a target with a small spot of illumination.

With respect to claims 2 and 3, applicant agrees that the perforated metal film disclosed by Kim et al. is opaque to the transmission of light, but submits that Kim et al. fail to disclose or suggest any mechanism for confining the extent of electronic excitation induced in the second surface to that portion of the second surface that is near each aperture.

In rejecting claim 5, the Examiner suggested that the transparent conductive layer 117 constitutes a confined conductive area in the vicinity of the apertures. However, as noted above, the confined area is clearly set forth in claim 1 to be an area on the second surface of the light barrier through which the apertures pass. The transparent conductive area 117 is thus not on the surface of the perforated light barrier. Moreover, the transparent conductive area 117 uniformly covers an entire array of apertures, and hence does not confine the electronic excitation induced in the second surface to that portion of the second surface that is near each aperture as claimed.

For these reasons, it is submitted that the subject matter set forth in independent claims 1-3, 5 and 21 as amended is clearly different from and represents invention over the control arrangement described in the Kim et al. patent. Reconsideration of the rejection under 35 U.S.C. §102(e) is respectfully requested.

Claim Rejections – 35 USC §103

Claims 4, 6, 8 and 22-25 were rejected under §103(a) based on Kim et al. Patent 6,040,936 without the citation of supporting references.

With respect to claim 4, the Examiner concedes that Kim et al. do not disclose a layer of conductive material that extends into the interior sidewalls of each aperture terminating at the second surface of the barrier in a limited area in the vicinity of each aperture. The Examiner suggests that such a structure would be obvious in view of the Kim et al. patent's teaching, citing column 1, lines 1-30 and column 4, lines 60-67. But both of these passages deal with thin perforated films of solid metal. There is nothing in either passage to suggest either a structure consisting of a layer of conductive material on the sidewalls of the aperture which terminates in a limited area in the vicinity of each aperture as claimed, nor is there any recognition in the cited passages of the reason for creating such a structure (i.e., limiting the spot size of the illumination on a nearby target). Nothing in either passage suggests anything other than a solid metal film which does not confine the electronic excitation induced in the second surface to a limited conductive area near each aperture as claimed

Claim 6, rejected solely because it was dependent on a rejected claim, sets forth a conductive layer positioned at the second surface and a groove in this conductive layer which surrounds each aperture to define a confined conductive area. No such structure of function is disclosed or suggested by Kim et al.

In rejecting claim 8 which is directed to a light barrier consisting of two different metals having different resonances, the Examiner points to the multiple layers of the Kim et al. light control apparatus and suggests that these could be formed of different metals. However, as noted above, claim 1 requires that the apertures pass through the light barrier, and the only thing the apertures pass through in the Kim et al. arrangement is a single metal film. There is nothing in Kim et al. which would suggest that the light barrier through which the apertures pass be constructed of two metals, and more particularly two metals having different resonances in order to confine the electronic excitation at the exit surface to the vicinity of each aperture exit. Reconsideration of the rejection of claim 8 is accordingly requested.

Claims 21 and 22 were rejected solely because they are dependent upon rejected claim 21. These claims are directed to a light barrier through which apertures pass that is composed of

a layer of electrically conductive metal exposed to radiation and a second layer which is either a dielectric having a bandgap larger than the frequency of electromagnetic radiation (claim 21) or a second layer constructed of a metallic material different from the electrically conductive metal and having a substantially different resonance. Kim et al. teach a light barrier consisting of a perforated metal film and there is no suggestion of a multiple layer light barrier through which the sub-wavelength apertures pass, nor any reason for creating such a structure.

Claims 24, 25 and 26 respectively state that the target upon which the desired small spot illumination is directed takes the form of an optical storage medium (claim 24), a sample viewed by the objective lens of a microscope (claim 25), or a photoresist exposed during a lithographic process (claim 26). The targets set forth in claims 24-26 are used in systems which benefit from the small spot size produced by the novel light barrier structure defined in claim 1. Because the Kim et al. light control apparatus is not concerned with reducing the spot size of the illumination produced at the exit of the apertures from the light barrier, the combination of the Kim et al. structure and these targets would not yield the results obtained by these applications of applicant's invention; namely, increased storage density in an optical storage medium; increased resolution for microscopy; and increased resolution and throughput for lithography. It is submitted that combinations claimed for providing these benefits are neither disclosed nor suggested by the Kim et al. patent. This is not to suggest that the desirability of achieving small spot sizes for such applications is not well known; rather, it is submitted that the cited Kim et. al patent does not suggest the methods and structures claimed by applicant for reducing the spot size produced by sub-wavelength apertures.

Claims 7, 9-13 and 26 were rejected under §103(a) based on Kim et al. Patent 6,040,936 when considered in view of Thio Patent 6,441,298.

Claim 7 and its dependent claims 9-13 require the presence of a barrier material that is (1) a dielectric and (2) that exhibits a bandgap that is larger than the frequency of the electromagnetic radiation forms part of the light barrier through which the apertures pass. The Examiner cites column 7, lines 60-65 and column 1, lines 35-40 and 60-67 of the Kim et al. patent which state that the perforated metal film must be optically thick (opaque to light) and are adjacent to a dielectric medium. Nothing in the cited passages of the Kim et al. patent suggests that the perforated light barrier itself, through which the apertures pass, should include a dielectric material.

The Examiner further cites column 6, lines 5-30 of the Thio patent which describes a photovoltaic cell in which spherical semiconductor devices are positioned at the light exit of each aperture through an illuminated thin metal film. The Thio patent indicates that the excitation spectrum of the spherical semiconductor device is determined in part by the bandgap of the semiconductor. This teaching does not suggest that the disclosed perforated thin metal film should be replaced with the combination of a metal film and a dielectric which should have a bandgap greater than the frequency the radiation.

It is accordingly submitted that the combination defined by claims 7 and its dependent claims 9-13 is neither disclosed nor suggested by either the Kim et al or Thio references.

With respect to claim 26, which is dependent on claim 1 and defines the target which receives the small spot illumination as being a photoresist in a lithographic process, the Examiner cites Theo at column 3, lines 10-30 and column 9, lines 1-11 which deal with lithographic methods for fabricating the photovoltaic cell structures described. This teaching says nothing about the use of the claimed novel light barrier configurations which concentrate light into small spot sizes by confining the area of surface excitation to a region near the exit of the sub-wavelength apertures through the light barrier. Instead, it is merely a description of the use of lithography in the fabrication of small semiconductor structures. Reconsideration of the rejection of claim 26 based on the combined teachings of Kim et al. and Thio is accordingly requested.

Claim 14 and its dependent claims 15-20 were rejected as being unpatentable §103(a) in view of Kim et al. Patent 6,040,936 considered in view of Ebbesen et al. Patent 6,236,030. Claim 14 has been amended to clarify the fact that the sub-wavelength width apertures pass through the combination of a conductive metal layer at the illuminated surface and an opaque radiation barrier. For the reasons presented with respect to claim 1, this structure is nowhere suggested by the Kim et al. patent. The cited Ebbesen patent 6,236,033 teaches the use of a perforated metal film which further includes surface indentations or other surface topography features which enhance the transmission of light through the apertures. Ebbesen does not, however, disclose or suggest a structure which defines a confined conductive area in the vicinity of each of said apertures at the exit surface to reduce the area of area of illumination on a target. Ebbesen's light barrier is a metal film with raised or recessed grooves or dimples which enhance light transmission through the apertures through the film. Neither Ebbesen nor Kim et al.,

whether considered alone or together, suggest the claimed combination set forth in claims 14-20 of a conductive metal layer on the illuminated surface of a radiation barrier that is opaque to the transmitted radiation, with apertures through the conductive layer and the radiation barrier, and a confined conductive area in the vicinity of each apertures at the exit surface which reduces the area of area of illumination on a target.

Conclusion

It is submitted that claims 1-26 as amended by this response clearly distinguish over and represent invention over the cited references. Allowance of all claims as now presented is accordingly requested.

Respectfully submitted,

Dated: November 21, 2003

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Certificate of Transmission under 37 CFR 1.8

I hereby certify that this *Amendment* is being transmitted by facsimile to the Commissioner for Patents at (703) 872-9306.on November 21, 2003

Dated: November 21 2003 Signature

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